THE AQUATIC PLANT COMMUNITY OF CAMELOT LAKE CHANNEL ADAMS COUNTY 2006

I. INTRODUCTION

An updated aquatic macrophytes (plants) field study of the Camelot Lake Channel was conducted during August 2006 by a staff member the Adams County Land and Water Conservatism Department and a staff member of the Tri-Lakes Management District. The first quantitative vegetation study was performed by Wisconsin Department of Natural Resources staff in 2000.

Information about the diversity, density and distribution of aquatic plants is an essential component in understanding the lake ecosystem due to the integral ecological role of aquatic vegetation in the lake and the ability of vegetation to impact water quality (Dennison et al, 1993). This study will provide information useful for effective management of the Camelot Lake Channel, including fish habitat improvement, protection of sensitive areas, aquatic plant management, and water resource regulation. This data will be compared to the past and future studies and to offer insight into changes in the lake.

Ecological Role: Lake plant life is the beginning of the lake's food chain, the foundation for all other lake life. Aquatic plants and algae provide food and oxygen for fish and wildlife, as well as cover and food for the invertebrates that many aquatic organisms depend on. Plants provide habitat and protective cover for aquatic animals. They also improve water quality, protect shorelines and lake bottoms, add to the aesthetic quality of the lake, and impact recreation.

Characterization of Water Quality: Aquatic plants can serve as indicators of water quality because of their sensitivity to water quality parameters such as clarity and nutrient levels (Dennison et al, 1993).

Testing has shown that both Camelot Lakes very hard water. Lake water pH has ranged from 6.3 to 8.21. Hard water lakes tend to produce more fish and aquatic plants than soft water lakes.

Background and History: The Camelot Lake Channel is located in the Town of Rome, Adams County, Wisconsin. It connects Upper and Lower Camelot Lakes s and is heavily developed. During the summer of 2006 when this aquatic plant survey was conducted, the channel was at slightly lower level than usual due to drought and very hot weather. Camelot dams impound Fourteen-Mile Creek downstream upstream from Arrowhead Lake and Sherwood Lake, on its way to the Wisconsin River.

Soils in the Channel area are sands of various slopes. Such soils tend to be excessively-drained, with infiltration of water being rapid to very rapid, and permeability also high. Such soils also usually have a low water-holding and low organic matter content, thus making them difficult to establish vegetation on. These soils tend to be easily eroded by both water and wind.

Efforts at controlling aquatic plant growth have included both chemical treatments and mechanical harvesting.

An aquatic plant survey was conducted by WDNR staff in 2000. This survey found that 90% of the sample sites in the channel were vegetated with aquatic plants, with the 0-1.5' depth supporting the highest mean number of species per site. The plant-like algae, *Chara* spp (muskgrass),was the most frequently-occurring aquatic "plant" species in the Camelot channel, followed by *Najas flexilis.* Only *Chara spp.* occurred at more than 50% frequency, although *Najas flexilis* was close at 48.39%. *Chara spp* also had the highest density and was the only species occurring at more than average density. Other plants found in the channel included *Carex lacustris, Eleocharis acicularis, Eleocharis palustris, Elodea canadensis, Potamogeton nodosus, Potamogeton pectinatus, Potamogeton pusillus, Potamogeton zosteriformis, Typha angustifolia* and *Zosterella dubia.* In addition, two invasives, *Myriophyllum spicatum* (Eurasian watermilfoil) and *Phalaris arundinacea* (Reed Canarygrass) were found in 2000, although neither of them occurred at high frequency, density or dominance.

II. METHODS

Field Methods

The 2000 and 2006 studies were both based on the rake-sampling method developed by Jessen and Lound (1962), using the same stratified random transects. The shoreline was divided into 19 equal sections, with one transect placed randomly within each segment, perpendicular to the shoreline.

One sampling site was randomly chosen in each depth zone (0-1.5'; 1.5'-5'; 5'-10'; 10'-20') along each transect. Using long-handled, steel thatching rakes, four rake samples were taken at each site. Samples were taken from each quarter around the boat. Aquatic species present on each rake were recorded and given a density rating of 0-5.

A rating of 1 indicates the species was present on 1 rake sample.

A rating of 2 indicates the species was present on 2 rake samples.

A rating of 3 indicates the species was present on 3 rake samples.

A rating of 4 indicates the species was present on 4 rake samples.

A rating of 5 indicates that the species was abundantly present on all rake samples.

A visual inspection and periodic samples were taken between transects to record the presence of any species that didn't occur at the raking sites. Gleason and Cronquist (1991) nomenclature was used in recording plants found.

Shoreline type was also recorded at each transect. Visual inspection was made of 50' to the right and left of the boat along the shoreline, 35' back from the shore (so total view was 100' x 35'). Percent of land use within this rectangle was visually estimated and recorded.

Data Analysis:

The percent frequency (number of sampling sites at which it occurred/total number of sampling sites) of each species was calculated. Relative frequency (number of species occurrences/total of all species occurrences) was also calculated. The mean density (sum of species' density rating/number of sampling sites) was calculated for each species. Relative density (sum of species' density/total plant density) was also calculated. "Mean density where present" (sum of species' density rating/number of sampling sites at which the species occurred) was calculated. Relative frequency and relative density results were summed to obtain a dominance value. Species diversity was measured by Simpson's Diversity Index.

The Average Coefficient of Conservatism and Floristic Quality Index were calculated as outlined by Nichols (1998) to measure plant community disturbance. A coefficient of Conservatism is an assigned value between 0 and 10 that measures the probability that the species will occur in an undisturbed habitat. The Average Coefficient of Conservatism is the mean of the coefficients for the species found in the lake. The coefficient of conservatism is used to calculate the Floristic Quality Index, a measure of a plant community's closeness to an undisturbed condition.

To measure the quality of the aquatic plant community, an Aquatic Macrophyte Index was determined using the method developed by Nichols et al (2000). This measurement looks at the following seven parameters and assigns each of them a number on a scale of 1-10: maximum depth of plant growth; percentage of littoral zone vegetated; Simpson's diversity index; relative frequency of submersed species; relative frequency of sensitive species; taxa number; and relative frequency of exotic species. The average total for the North Central Hardwoods lakes and impoundments is between 48 and 57.

III. RESULTS

Physical Data

The aquatic plant community can be impacted by several physical parameters. Water quality, including nutrients, algae and clarity, influence the plant community; the plant community in turn can modify these boundaries. Lake morphology, sediment composition and shoreline use also affect the plant community.

Lake morphology is an important factor in distribution of lake plants. Duarte & Kalff (1986) determined that the slope of a littoral zone could explain 72% of the observed variability in the growth of submerged plants. Gentle slopes support higher plant growth than steep slopes (Engel 1985).

Camelot Channel is a narrow channel connecting two lakes that are the first a series of impoundments that are originally fed by a very large, multi-county stream system. The channel is shallow, with a maximum depth of about 13'. With fair water clarity and shallow depths, plant growth may be favored in the Channel, since the sun reaches much of the sediment to stimulate plant growth.

Sediment composition can also affect plant growth, especially those rooted. The richness or sterility and texture of the sediment will determine the type and abundance of macrophyte species that can survive in a particular.

Table 1: Sediment Composition—Camelot Channel

		Zone 1	Zone 2	Zone 3	Zone 4	Overall
Hard	Sand	50.00%	10.00%	60.00%	100.00%	41.94%
Sediment						
Mixed	Sand/Peat	10.00%	10.00%			6.45%
Sediment						
Soft	Peat	20.00%	70.00%	40.00%		41.94%
Sediment	Peat/Muck	10.00%	10.00%			6.45%
	Silt	10.00%				3.22%

Nearly 42% of the sediment in Camelot is hard, with little natural fertility and low available water holding capacity; another 42% is soft, with high natural fertility and water-holding capacity. Although sandy sediment may limit growth, most hard sediment sites in Camelot Channel were vegetated. 96.8% sample sites were vegetated in the Camelot Channel, no matter what the sediment. Most sites unvegetated sites appeared to have had vegetation cleared by hand harvesting.

Shoreline land use often strongly impacts the aquatic plant community and thus the entire aquatic community. Impacts can be caused by increased erosion and sedimentation and higher run-off of nutrients, fertilizers and toxins applied to the land. Such impacts occur in both rural and residential settings.

Some type of naturally vegetated shoreline covered only 11.0% of the lake shoreline in 2006, down substantially from 2000, when it covered 38.5%. In both years, disturbed shorelines—including bare sand, traditional cultivated lawn, hard structure (piers, decks, seawalls, etc.) and rock riprap--were the most frequently-occurring. Overall, they covered 89.0% of the shore of Camelot Channel in 2006, up from 61.5% in 2000.

Table 3: Shoreland Land Use—Camelot Channel—2000 and 2006

		2006 Frequency	2000 Frequency	2006 Coverage	2000 Coverage
Natural	Herbaceous	30.00%	50.00%	8.00%	29.50%
Shoreline	Shrub	0.00%	20.00%	0.00%	1.00%
	Wooded	20.00%	40.00%	3.00%	8.00%
Disturbed	Bare Sand/Eroded	80.00%	50.00%	13.50%	7.00%
Shoreline	Cultivated Lawn	90.00%	70.00%	56.00%	49.00%
	Hard Structure	90.00%	60.00%	13.00%	3.50%
	Rock Riprap	40.00%	20.00%	6.50%	2.00%

<u>Macrophyte Data</u>

SPECIES PRESENT

Of the 28 species found in the Camelot Channel, 25 were native and 3 were exotic invasives. In the native plant category, 9 were emergent, 1 was a floating-leaf plant, and 15 were submergent species. Three exotic invasives, *Myriophyllum spicatum* (Eurasian Watermilfoil) , *Phalaris arundinacea* (Reed Canarygrass) and *Potamogeton* crispus (Curly-Leaf Pondweed) were found.

Comparing the species found in 2006 to those reported in 2000, some changes are evident. Plants found in 2006 that were not found in 2000 included: *Impatiens capensis* (emergent); *Leersia* oryzoides (emergent); *Polygonum amphibium* (floating-leaf); *Potamgeton amplifolius* (submergent); *Potamogeton cripus* (submergent); Potamogeton *gramineus* (variable-leaf pondweed); *Potamogeton illinoensis* (emergent); *Sagittaria* spp (emergent); *Salix* spp (emergent); *Scirpus* validus (emergent); *Sparganium* spp (emergent); *Vallisneria americana* (submergent); and *Wolffia columbiana* (free-floating). Since the 2006 plant survey was conducted in August, past the prime growing season for *Potamogeton crispus*, it is possible that *P. crispus* was present earlier in the summer in 2006, since it was found in 2000.

Table 4—Plants Found in Camelot Channel, 2006

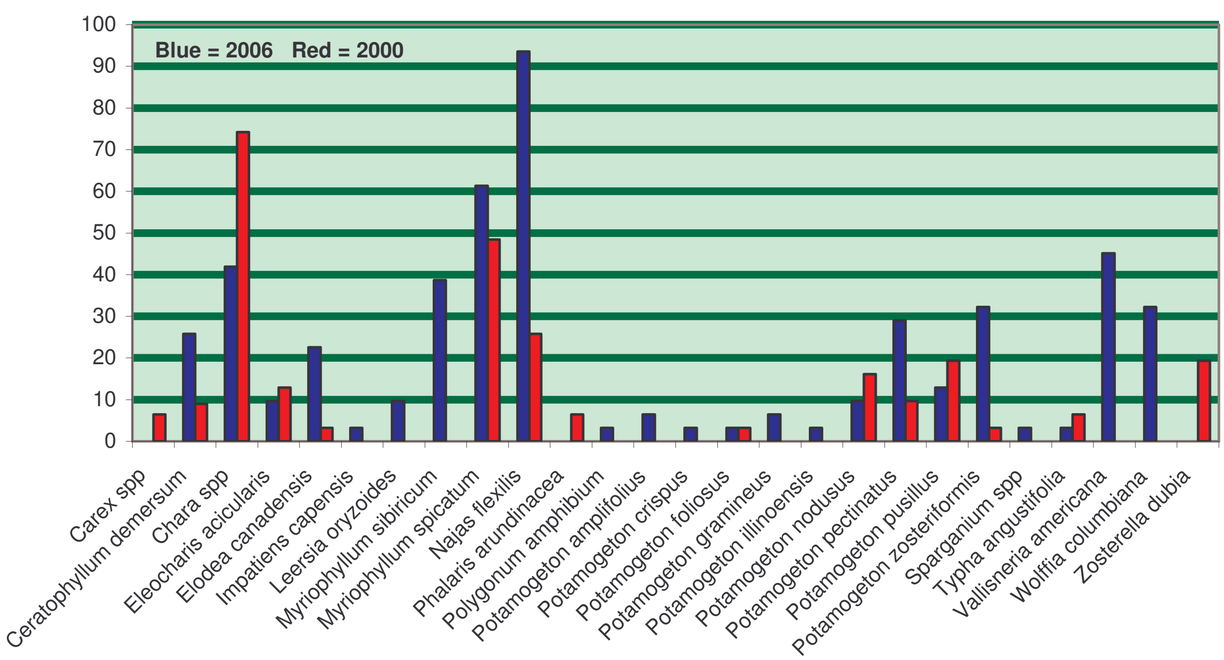
Scientific Name	Common Name	Type	Found in 2000
Carex spp	Sedges	Emergent	x
Ceratophyllum demersum	Coontail	Submergent	x
Chara spp	Muskgrass	Submergent	x
Eleocharis acicularis	Needle Spikerush	Emergent	x
Elodea canadensis	Waterweed	Submergent	x
Impatiens capensis	Jewelweed	Emergent	
Leersia oryzoides	Rice Cut-Grass	Emergent	
Myriophyllum sibiricum	Northern Milfoil	Submergent	
Myriophyllum spicatum	Eurasian Watermilfoil	Submergent	x
Najas flexilis	Bushy Pondweed	Submergent	x
Phalaris arundinacea	Reed Canarygrass	Emergent	x
Polygonum amphibium	Water Smartweed	Floating-Leaf	
Potamogeton amplifolius	Large-Leaf Pondweed	Submergent	
Potamogeton cripus	Curly-Leaf Pondweed	Submergent	
Potamogeton foliosus	Leafy Pondweed	Submergent	x
Potamogeton gramineus	Variable-Leaf Pondweed	Submergent	
Potamogeton illinoensis	Illinois Pondweed	Submergent	
Potamogeton nodusus	Long-Leaf Pondweed	Submergent	x
Potamogeton pectinatus	Sago Pondweed	Submergent	x
Potamogeton pusillus	Small Pondweed	Submergent	x
Potamogeton zosteriformis	Flat-Stem Pondweed	Submergent	x
Sagittaria spp	Arrowhead	Emergent	
Salix spp	Willow	Emergent	
Scirpus validus	Soft-Stem Bulrush	Emergent	
Sparganium spp	Burreed	Emergent	
Typha angustifolia	Narrow-Leaf Cattail	Emergent	x
Vallisneria americana	Water Celery	Submergent	
Wolffia columbiana	Watermeal	Free-Floating	

Of the plants on this list, several are species likely to increase in frequency and/or density in the case of regular drawdowns: *Carex spp* (emergent); *Leersia oryzoides* (emergent); *Najas flexilis* (submergent); *Potamogeton crispus* (submergent exotic); *Potamogeton pectinatus* (submergent); *Scirpus validus* (emergent) and *Potamogeton zosteriformis* (submergent). Some also tend to decrease with regular drawdowns: *Chara spp* (submergent); *Myriophyllum* *sibiricum* (submergent); *Myriophyllum spicatum* (submergent exotic); and *Vallisneria americana* (submergent). In general, regular drawdowns will tend to encourage the increase of plants that can survive frequent disturbances and will also tend to reduce the diversity of the aquatic plant community

FREQUENCY OF OCCURRENCE

Najas flexilis was the most frequently-occurring plant in Camelot Channel in 2006 (with 93.55% occurrence frequency), followed by *Myriophyllum spicatum* at 61.29 % occurrence frequency. In 2000, *Chara* spp. was the most-frequency occurring species, with *Myriophyllum spicatum* second with 48.39% occurrence frequency. No other species reached a frequency of 50% or greater in the lake overall in either 2000 or 2006.

Chart 1: Occurrence Frequency

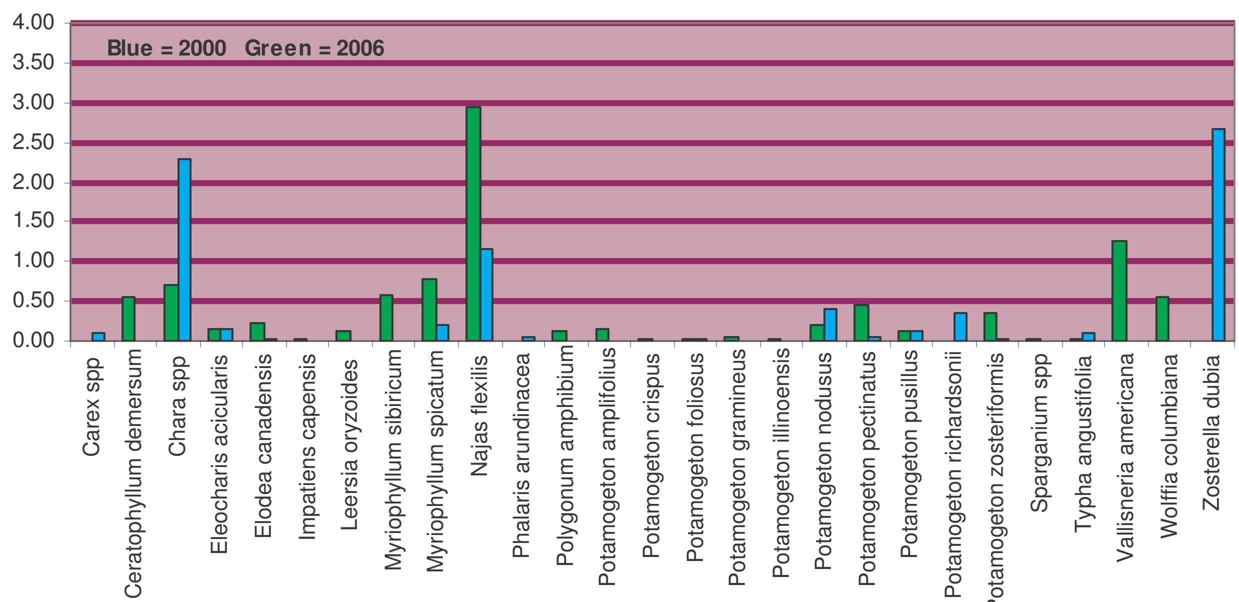


Filamentous algae were found at 25.58% of the sample sites in 2006 and at 33.33% of the sites in 2000.

DENSITY OF OCCURRENCE

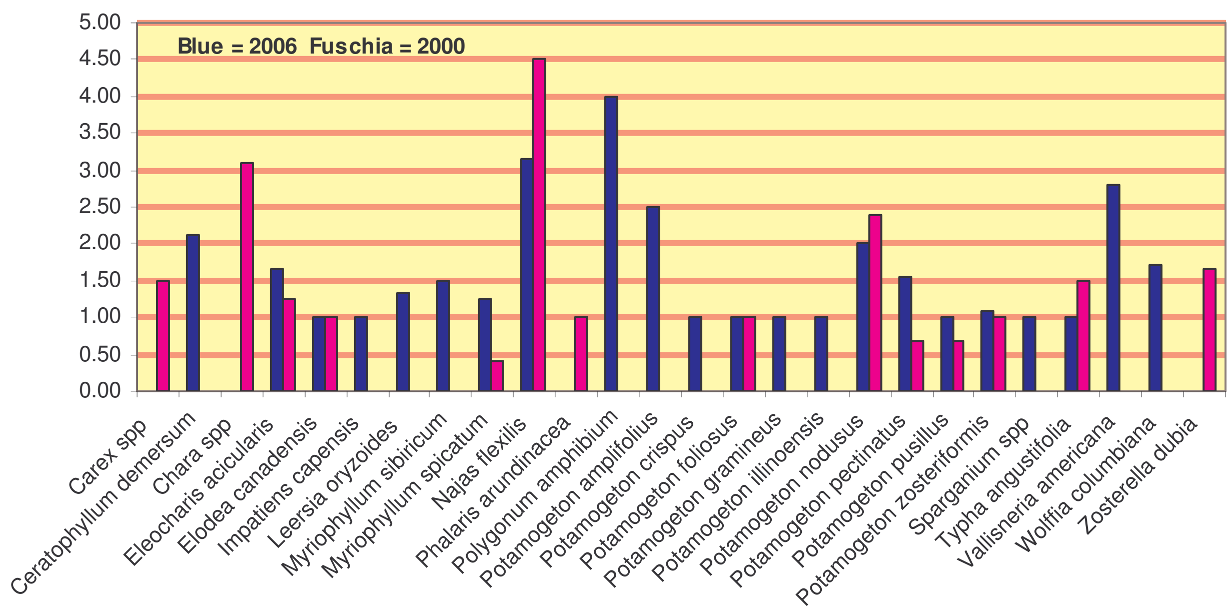
Najas flexilis was also the densest plant in 2006 in Camelot Channel, with a mean density of 2.94 (on a scale of 1 to 4). In the lake overall, it was the only species of aquatic vegetation that had a mean density of over 2.0, meaning it occurred at more than average density, in 2006. In 2006, it was the only species that occurred at more than average density in Depth Zones 1 and 2. Depth Zone 3 had *Vallisneria americana* at more than average density, in addition to *Najas flexilis,* and Zone 4 had *Ceratophyllum demersum* more than average density, but not *Najas flexilis*.

Chart 2: Mean Density



However, when looking at the "mean density where present", more plants had a more than average density in 2006: in addition to *Najas flexilis, Chara* spp*, Polygonum amphibium, Potamogeton amplifolius* and *Vallisneria americana* all had higher than average densities of growth where they were present. These figures indicate some areas in the lake have higher than average density growth form that can interfere with fish habitat and recreational use.

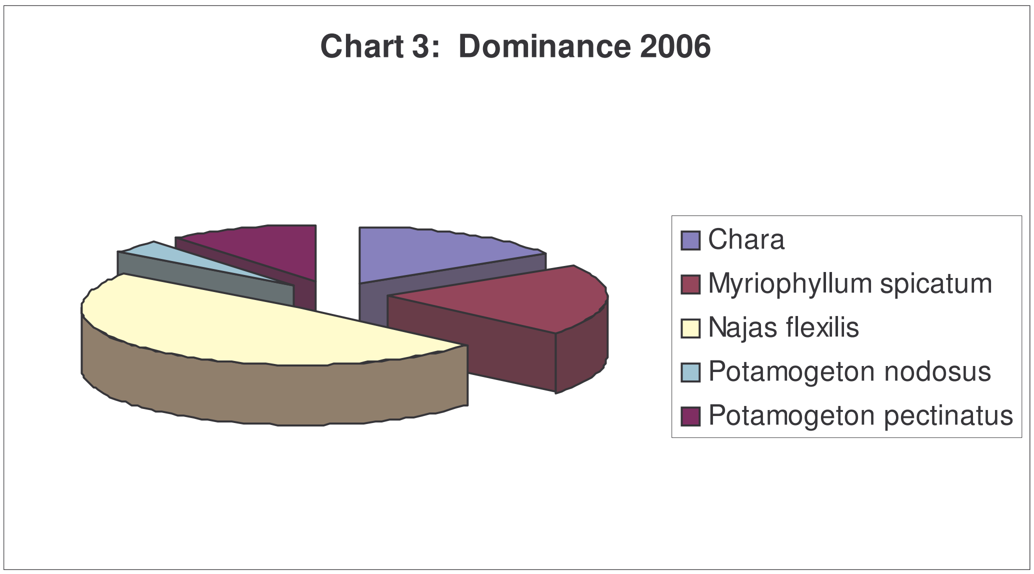
Chart 2A: Mean Density Where Present



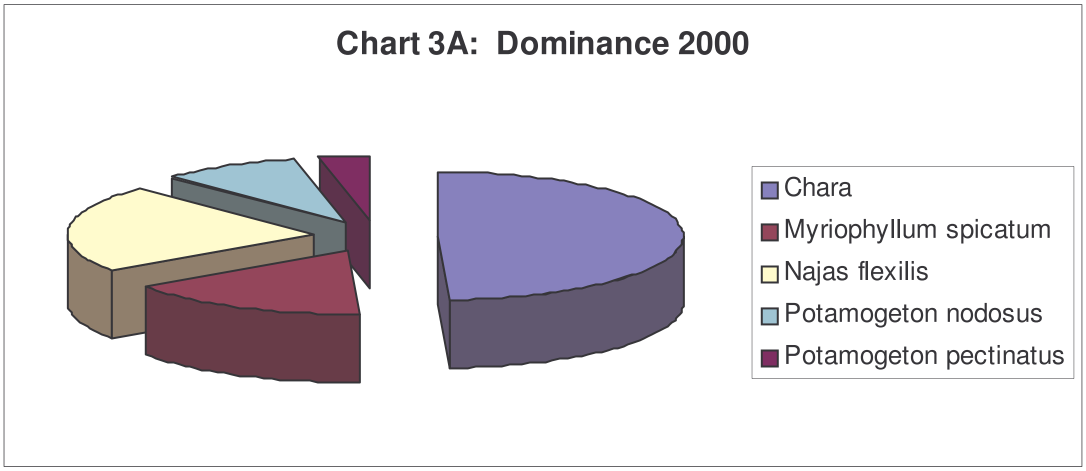
In 2000, only three species occurred at more than average density where present than in 2006: *Chara* spp., *Najas flexilis,* and *Potamogeton nodusus.*

DOMINANCE

Relative frequency and relative density are combined into a dominance value that demonstrates how dominant a species is within its aquatic plant community. Based on dominance value, *Najas flexilis* was the dominant aquatic plant species in Camelot Channel in 2006. *Chara* spp dominated the aquatic plant community of Camelot Channel in 2000.



In 2006, *Najas flexilis* was dominant in Depth Zone 1, with *Ceratophyllum demersum* subdominant. *Najas flexilis* was dominant in Depth Zone 2, with *Chara* spp subdominant. *Najas flexilis* dominated Depth Zone 3, but was co-deominant with *Ceratophyllum demersum* in Depth Zone 4.



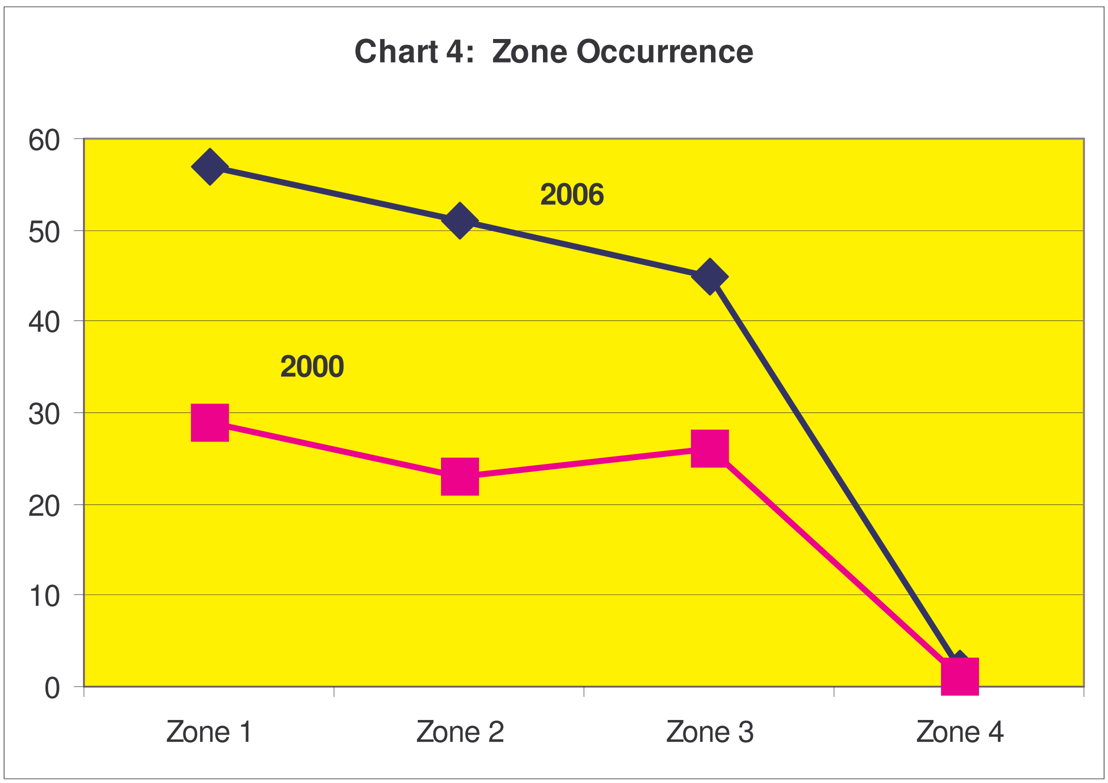
Chara spp was dominant in Zone 1 in 2000, with *Najas flexilis* sub-dominant. In Depth Zones 2 and 3, *Chara* spp was also dominant, but *Myriophyllum spicatum* was sub-dominant. *Najas flexilis* dominated Depth Zone 4 in 2000.

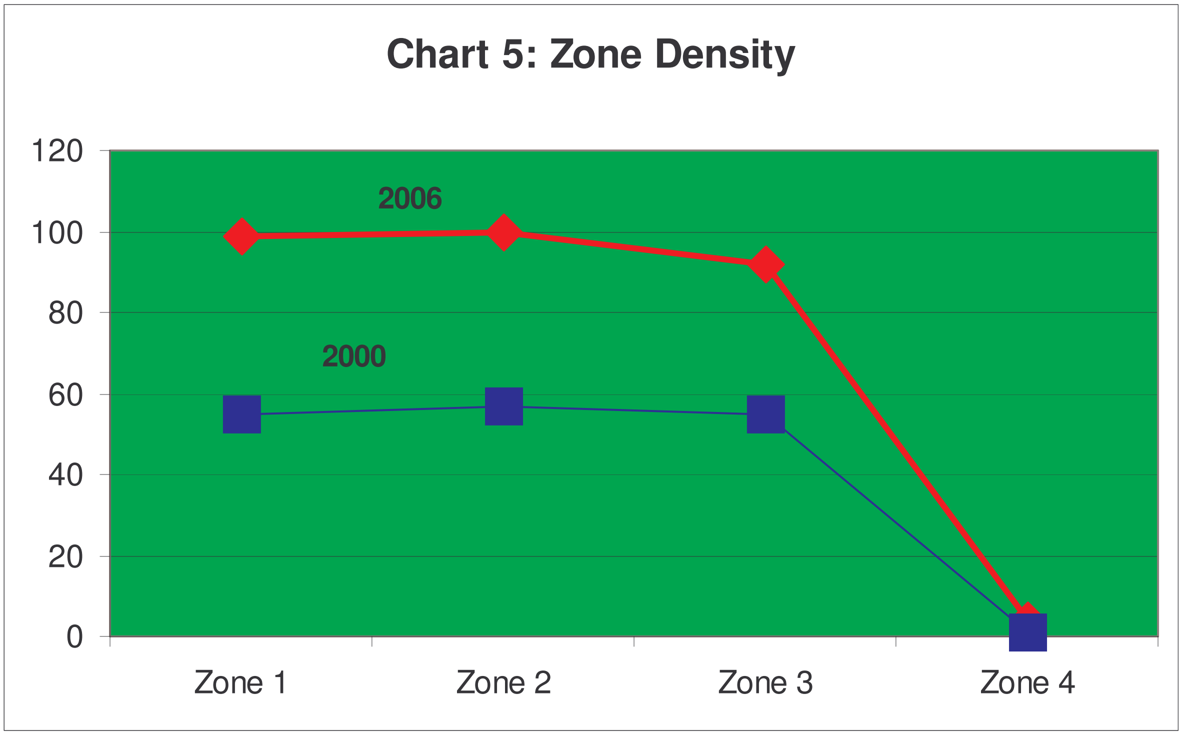
DISTRIBUTION

Aquatic plants occurred at 96.8% of the sample sites in Camelot Channel to a maximum rooting depth of 10.5'. Vegetation occurrence found in 2000 was 90.3%, but the maximum rooting depth then was 13'. Free-floating plants were found in the first three depth zones in both years. Filamentous algae were found in the three shallowest zones in both 2000 and 2006.

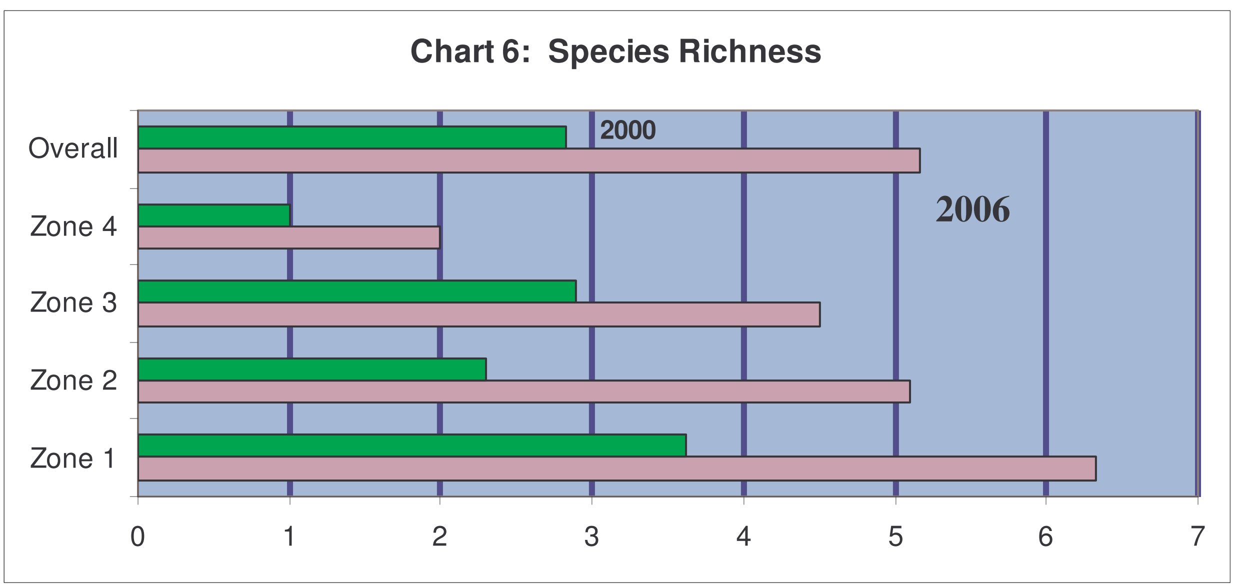
In 2006, 0-1.5' depth zone (Zone 1) supported the most total occurrence of plant growth. Zones 2 and 3 were close in total occurrence, then there was a sharp drop in occurrence for Depth Zone 4. The pattern was different in 2000: the first three depth zones were very close in total plant occurrence, although there was still a sharp drop for Zone 4.

For total plant density in 2006, Depth Zone 2 had the most total density, with Depth Zone 3 and Depth Zone 1 being close in total density. A sharp drop in density characterized density in Depth Zone 4. In 2000, the first three zones had similar density, then again a sharp drop for Zone 4.





Species richness increased between 2000 and 2006, with the biggest increase in richness found in Depth Zone 2 (1.5’-5’).



THE COMMUNITY

The Simpson's Diversity Index for Camelot Channel in 2006 was .91, indicating good species diversity. A rating of 1.0 would mean that each plant in the channel was a different species (the most diversity achievable). This places it in the upper quartile for Simpson's Diversity Index readings for both North Central Hardwood Forest Region and all Wisconsin lakes. The 2006 AMCI for Camelot Channel is 52, placing its quality in the average range for North Central Wisconsin Lakes and all Wisconsin Lakes. The AMCI value for 2000, 45, was below average.

Table 5: Aquatic Macrophyte Community Index-2006 & 2000

	2006	2006 Value	2000	2000 Value
Max. Rooting Depth	10.5'	5	13'	7
% Littoral Vegetated	96.80%	10	90.30%	10
% Submersed Spec.	87%	9	87%	9
% Exotic Species	13%	4	13%	4
% Sensitive Spec	10%	6	2%	3
Simpson's Index	0.91	9	0.85	6
Taxa #	25	9	13	6
		52		45

Using the AMCI index, some change has occurred in Camelot Channel between 2000 and 2006.

The presence of several invasive, exotic species could be a significant factor in the future. Currently, *Myriophyllum spicatum* had an occurrence frequency over 60%, despite the long history of both chemical and mechanical control efforts. This plant must continue to be monitored, since its tenacity and ability to spread to large areas fairly quickly could make it a danger to the diversity of Camelot Channel's current aquatic plant community. *Potamogeton crispus* was found in

Camelot Channel in 2006, but not found in the 2000 survey. Since the 2006 survey was conducted in August, it is possible that some of the *Potamogeton crispus* that had simply died off by then, since *P. crispus* tends to be an early-season plant. The channel should also be further monitored for this invasive.

The Average Coefficient of Conservatism and a Floristic Quality Index calculation were performed on the field results. Technically, the Average Coefficient of Conservatism measures the community's sensitivity to disturbance, while the Floristic Quality Index measures the community's closeness to an undisturbed condition. Indirectly, they measure past and/or current disturbance to the particular community.

Previously, a value was assigned to all plants known in Wisconsin to categorize their probability of occurring in an undisturbed habitat. This value is called the plant's Coefficient of Conservatism. A score of 0 indicates a native or alien opportunistic invasive plant. Plants with a value of 1 to 3 are widespread native plants. Values of 4 to 6 describe native plants found most commonly in early successional ecosystem. Plants scoring 6 to 8 are native plants found in stable climax conditions. Finally, plants with a value of 9 or 10 are native plants found in areas of high quality and are often rare, endangered or threatened. In other words, the lower the numerical value a plant has, the more likely it is to be found in disturbed areas.

The Average Coefficient of Conservatism in the Camelot Channel in 2006 was 4.68 and 4.38 in 2000. This puts the channel in the lowest quartile for Wisconsin Lakes (average 6.0) and for lakes in the North Central Hardwood Region (average 5.6). The aquatic plant community in the Camelot Channel is in the category of those very tolerant of disturbance, probably due to selection by a series of past disturbances and current heavy shore development.

The Floristic Quality Index of the aquatic plant community in the Camelot Channel of 21.96 in 2006 is just below average for all Wisconsin Lakes (average 22.2) and just above the average for the North Central Hardwood Region (average 20.9). This suggests that the plant community in Camelot Channel is about as far from an undisturbed condition as the average lake in Wisconsin overall and in the North Central Hardwood Region. However, the Floristic Quality Index has increased between 2000 and 2006, suggesting some small progress in overall aquatic plant health may be occurring. Using either the Average Coefficient of Conservatism or the Floristic Quality Index scales, the aquatic plant community in Camelot Channel apparently has impacted by a more than average amount of disturbance.

“Disturbance” is a term that covers many disruptions to a natural community. It includes physical disturbances to plant beds such as boat traffic, plant harvesting, chemical treatments, dock and other structure placements, shoreline development and fluctuating water levels. Indirect disturbances like sedimentation, erosion, increased algal growth, and other water quality impacts will also negatively affect an aquatic plant community. Biological disturbances such as the introduction of non-native and/or invasive species (such as the Eurasian Watermilfoil, Reed Canarygrass and Curly-Leaf Pondweed found here), destruction of plant beds, or changes in aquatic wildlife can also negatively impact an aquatic plant community. Shore development and sediment deposition can also reduce the quality of the aquatic plant community.

Out of the 10 transects sampled in the Camelot Channel, no site was totally naturally vegetated. Therefore, no statistical evaluation comparing the aquatic macrophyte communities at disturbed vs. natural shores was appropriate.

IV. DISCUSSION

Based on a review of information for both Upper and Lower Camelot Lakes, it is suspected that sufficient nutrients (trophic state), fair water clarity, shallow lake, hard water and nutrient-rich input from heavy shore development at Camelot Channel favor plant growth. Despite the sometime limiting effect of sand sediments on aquatic plant growth, over 96% of the Channel is vegetated, suggesting that even the heavily-sandy sediments in the Camelot Channel hold sufficient nutrients to maintain aquatic plant growth.

Historically, many aquatic plant treatments in Camelot Channel were chemical. There has been mechanical harvesting to try to reduce plant growth in the last 10 years or so. A continued regular schedule and pattern of machine harvesting will help in removing vegetation from the lake and may help with nutrient reduction. The harvesting should also be designed to set back the growth of Eurasian Watermilfoil, not spread it further. It might also help to skim off the filamentous algae.

The channel has some mixture of structure of emergent, free-floating, floating-leaf and submerged plants, although floating-leaf cover was very sparase. Of the 28 species found in the Camelot Channel, 25 were native and 3 were exotic invasives. In the native plant category, 9 were emergent, 1 was a floating-leaf plant, and 15 were submergent species. Three exotic invasives, *Myriophyllum* *spicatum* (Eurasian Watermilfoil) , *Phalaris arundinacea* (Reed Canarygrass) and *Potamogeton* crispus (Curly-Leaf Pondweed) were found.

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However, when looking at the "mean density where present", more plants had a growth form of more than average density in 2006: in addition to *Najas flexilis, Chara spp, Polygonum amphibium, Potamogeton amplifolius* and *Vallisneria americana* all had higher than average densities of growth where they were present. These figures indicate several species in the lake have higher than average growth density that can interfere with fish habitat and recreational use.

The very few areas of native vegetation and wetland shores on the channel should be preserved as they are to maintain habitat and to serve as a buffer for that area. Studies have suggested that runoff from such natural land is substantially less than that of developed areas. Shoreline restoration of native vegetation is badly needed on the Camelot Channel.

The Simpson's Diversity Index Camelot Channel in 2006 was .91, an indication of good species diversity. A rating of 1.0 would mean that each plant in the lake was a different species (the most diversity achievable). This places it in the upper quartile for Simpson's Diversity Index readings for both North Central Hardwood Forest and all Wisconsin lakes. The AMCI for Camelot Channel is 52, placing it in the average range for North Central Wisconsin Lakes and all Wisconsin Lakes.

Some type of native vegetated shoreline was covered only 11.0% of the lake shoreline. Disturbed shorelines---including bare sand, traditional cultivated lawn, hard structure (piers, decks, seawalls, etc.) and rock riprap---covered 89.0% of the shore of the Camelot Channel. These conditions offer little protection for water quality and have significant potential to negatively impact the Camelot Channel's water by increased runoff (including lawn fertilizers, pet waste, pesticides) and shore erosion.

	Changes in the Macrophyte Community			
Camelot Channel	2000	2006	Change	%Change
Number of Species	13	25	12	**92.31%**
Maximum Rooting Depth in Feet	13.0	10.5	-3	**-19.23%**
% of Littoral Zone Unvegetated	9.70%	3.20%	-0.065	-67.01%
%Sites/Emergents	10.13%	5.81%	0.0	-42.65%
%Sites/Free-floating	0.00%	3.87%	0.0	**3.87%**
%Sites/Submergents	89.87%	90.32%	0.0	**0.50%**
%Sites/Floating-leaf	0.00%	1.00%	0.0	
Simpson's Diversity Index	0.85	0.91	0.06	**7.06%**
Species Richness	2.82	5.17	2.35	**83.33%**
Floristic Quality	15.81	21.96	6.15	**38.90%**
Average Coefficient of Conservatism	4.38	4.68	0.30	**6.85%**
AMCI Index	45	52	7.00	**15.56%**

Further, when calculating the coefficient of similarity between the 2000 and 2006 surveys, they score as statistically dissimilar. Based on frequency of occurrence, the aquatic plant communities of the two years are only 45% similar. Similarity percentages of 75% or more are considered statistically similar; obviously, the Camelot Channel percentages are far from that. Emergent vegetation (an important habitat component) has decreased by nearly one-half, and floating-leaf vegetation is very sparse. Disturbance indicator, *Chara*, has decreased substantially, but another disturbance indicator, *Najas flexilis*, has increased, as has *Myriophyllum spicatum* (Eurasian Watermilfoil).

	Changes in Aquatic Plant Species				
Species		2000	2006	Year1-2	%
					Change
Ceratophyllum demersum	Frequency	0.00%	25.81%	0.2581	100.0%
	Mean Density	0	0.55	0.55	100.0%
	Dom. Value	0	0.11	0.11	100.0%
Chara spp	Frequency	74.19%	41.94%	-0.3225	-43.5%
	Mean Density	2.29	0.71	-1.58	-69.0%
	Dom. Value	0.71	0.16	-0.55	-77.5%
Eleocharis acicularis	Frequency	12.90%	9.68%	-0.0322	-25.0%
	Mean Density	0.16	0.16	0	0.0%
	Dom. Value	0.08	0.04	-0.04	-50.0%
Elodea canadensis	Frequency	3.23%	3.23%	0	0.0%
	Mean Density	0.03	0.23	0.2	666.7%
	Dom. Value	0.02	0.07	0.05	250.0%
Myriophyllum sibiricum	Frequency	0	38.71%	0.3871	100.0%
	Density	0	0.58	0.58	100.0%
	Imp. Val.	0	0.14	0.14	100.0%
Myriophllum spicatum	Frequency	48.39%	61.29%	0.129	26.7%
	Density	0.19	0.77	0.58	305.3%
	Imp. Val.	0.23	0.2	-0.03	-13.0%
Najas flexilis	Frequency	25.81%	93.55%	0.6774	262.5%
	Density	1.16	2.94	1.78	153.4%
	Imp. Val.	0.32	0.5	0.18	56.3%
Potamogeton amplifolius	Frequency	0	6.45%	0.0645	100.0%
	Density	0	0.16	0.16	100.0%
	Imp. Val.	0	0.02	0.02	100.0%

Potamogeton foliosus	Frequency	3.23%	3.23%	0	0.0%
	Density	0.03	0.03	0	0.0%
	Imp. Val.	0.02	0.01	-0.01	-50.0%
Potamogeton nodosus	Frequency	16.13%	9.68%	-0.0645	-40.0%
	Density	0.39	0.19	-0.2	-51.3%
	Imp. Val.	0.13	0.04	-0.09	-69.2%
Potamogeton pectinatus	Frequency	9.68%	29.03%	0.1935	199.9%
	Density	0.06	0.45	0.39	650.0%
	Imp. Val.	0.05	0.11	0.06	120.0%
Potamogeton pusillus	Frequency	19.35%	12.90%	-0.0645	-33.3%
	Density	0.13	0.13	0	0.0%
	Imp. Val.	0.1	0.04	-0.06	-60.0%
Potamogeton zosteriformis	Frequency	3.23%	32.26%	0.2903	898.8%
	Density	0.04	0.35	0.31	775.0%
	Imp. Val.	0.02	0.1	0.08	400.0%
Vallisneria americana	Frequency	0	45.16%	0.4516	100.0%
	Density	0	1.26	1.26	100.0%
	Imp. Val.	0	0.22	0.22	100.0%
Wolffia columbiana	Frequency	0	32.26%	0.3226	100.0%
	Density	0	0.55	0.55	100.0%
	Imp. Val.	0	0.12	0.12	100.0%
Zosterella dubia	Frequency	19.35%	0	-0.1935	-100.0%
	Density	0.32	0	-0.32	-100.0%
	Imp. Val.	0.14	0	-0.14	-100.0%

V. CONCLUSIONS

The Average Coefficient of Conservatism of the aquatic plant community in the Camelot Channel is below average for Wisconsin lakes and for lakes in the North Central Hardwood region, suggesting that disturbance has impacted the aquatic plant community. The aquatic plant community is average as measured by the Floristic Quality Index. The AMCI is in the average range for both North Central Hardwood Region and all Wisconsin lakes. Filamentous algae are present. Structurally, the aquatic plant community contains few emergent plants, free-floating or floating-leaf rooted. Submergent plants dominate the aquatic plant community in this lake.

Both in 2000 and 2006, over 90% of the littoral zone was vegetated. The potential for plant growth at all depths of the lake is present, even with many of the channel sediments sandy. This growth percent is over the recommended vegetation percentage for best fishing (50%-85%).

Najas flexilis was the most frequently-occurring plant in Camelot Channel in 2006 (with 93.55% occurrence frequency), followed by *Myriophyllum spicatum* at 61.29 % occurrence frequency. In 2000, *Chara* spp. was the most-frequency occurring species, with *Myriophyllum spicatum* second with 48.39% occurrence frequency. No other species reached a frequency of 50% or greater in the lake overall in either 2000 or 2006.

A healthy and diverse aquatic plant community plays a vital role within the lake ecosystem. Plants help improve water quality by trapping nutrients, debris and pollutants in the water body; by absorbing and/or breaking down some pollutants;

by reducing shore erosion by decreasing wave action and stabilizing shorelines and lake bottoms; and by tying-up nutrients that would otherwise be available for algae blooms. Aquatic plants provide valuable habitat resources for fish and wildlife, often being the base level for the multi-level food chain in the lake ecosystem, and also produce oxygen needed by animals.

Further, a healthy and diverse aquatic plant community can better resist the invasion of species (native and non-native) that might otherwise "take over" and create a lower quality aquatic plant community. A well-established and diverse plant community of natives can help check the growth of more tolerant (and less desirable) plants that would otherwise crowd out some of the more sensitive species, thus reducing diversity.

Vegetated lake bottoms support larger and more diverse invertebrate populations that in turn support larger and more diverse fish and wildlife populations (Engel, 1985). Also, a mixed stand of aquatic macrophytes (plants) supports 3 to 8 times more invertebrates and fish than do monocultural stands (Engel, 1990). A diverse plant community creates more microhabitats for the preferences of more species.

MANAGEMENT RECOMMENDATIONS

(1) Because the plant cover in the littoral zone of the Camelot Channel is over the ideal (25%-85%) coverage for balanced fishery and there are some areas with more than average plant density, continued harvesting to open fishing lanes should occur in some areas. Removal of no more than 30' per 100' per landowner shore should occur by hand in the shallower areas to be sure that entire plants are removed and to minimize the amount of disturbance to the sediment.

(2) Natural shoreline restoration and erosion control in many areas is badly needed.

(3) To protect water quality, a buffer area of native plants needs to be restored on those many sites that now have seawalls or have traditional lawns mowed to the water's edge. Large areas of the channel shoreline are unnatural and prone to erosion & runoff of nutrients & toxics. Unmowed native vegetation reduces runoff into the lake and filters runoff that enters the channel. Natural buffer coverage has decreased since 2000.

(4) The Tri-Lakes Management District and the Camelot Lake Association should continue to cooperate with the WDNR to monitor for zebra mussel introduction into Camelot Lake to protect the aquatic plant community in the Camelot Channel.

(5) Stormwater management of the surfaces around the channel is essential to maintain the current quality of the lake water and prevent further degradation.

(6) No lawn chemicals should be used on properties around channel. If they must be used, they should be used no closer than 50' to the shore.

(7) The aquatic plant management plan should be reviewed annually. Mechanical harvesting plans should continue target harvesting for Eurasian Watermilfoil (EWM) and include target harvesting for Curly-Lead Pondweed to prevent further spread. Mechanical harvesting must follow the plan outlined in the approved lake management plan.

(8) The Camelot Lake Association may want to continue to apply for grants from the Wisconsin Department of Natural Resources to help defray the cost of aquatic plant management.

(9) No broad-scale chemical treatments of aquatic plant growth are recommended due to the undesirable side-effects of such treatments, including increased

nutrients from decaying plant material and decreased dissolved oxygen and opening up more areas to the invasion of EWM.

(10) The Tri-Lakes Management District conducted limited water quality monitoring for several years, but has decreased its involvement during 2004-2006 when Adams Land & Water Conservation Department was doing more intense monitoring as part of a Lake Classification Grant. Monitoring by the Lake District or through the DNR Self-Help Monitoring Program should be restarted.

(11) Camelot Channel residents should identify, cooperate with and participate in watershed programs that will reduce nutrient and sediment inputs.

(12) No drawdowns of water level in the lakes except for DNR-approved purposes should occur. Several of the plants found in Camelot Channel in 2006 are those encouraged by drawdowns.

(13) The few sites where there is undisturbed shore should be maintained and left undisturbed.

(14) The Tri-Lakes Management District should make sure that its lake management plan takes into account all inputs from both the Camelot Channel surface ground watershed and inputs from Camelot & Sherwood Lakes, and addresses the concerns of this larger lake community.

(15) Pursue installation of sewage system around the lake to reduce nutrient input from the lakeshores. Reducing nutrient inputs by residents needs to occur before asking watershed residents to reduce theirs.

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